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Carquinez Transmission Span

The Journal of ELECTRICITY POWER AND GAS

DEVOTED TO THE CONVERSION, TRANSMISSION AND DISTRIBUTION OF ENERGY.

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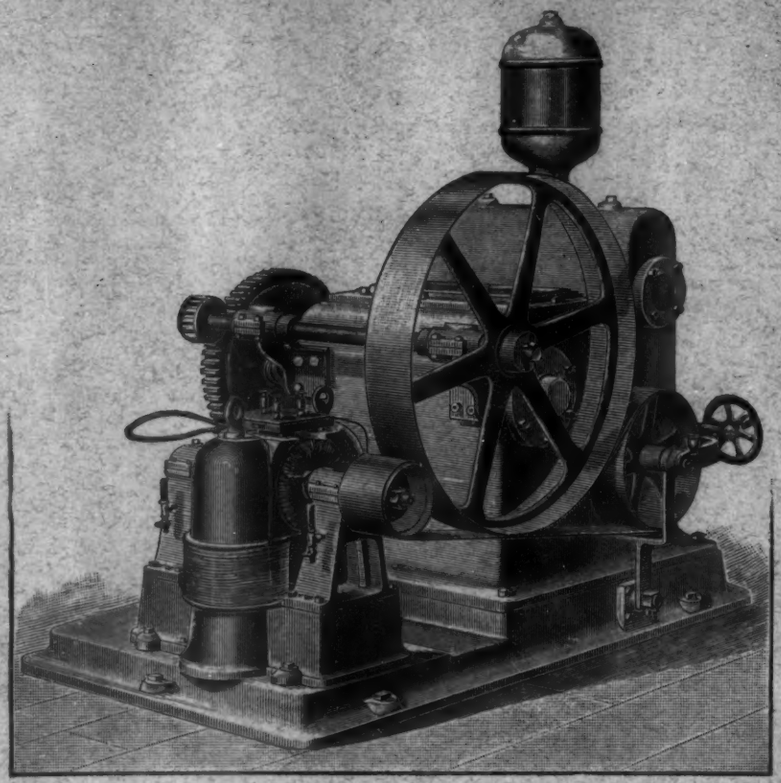

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THE JOURNAL OF ELECTRICITY, POWER AND GAS.

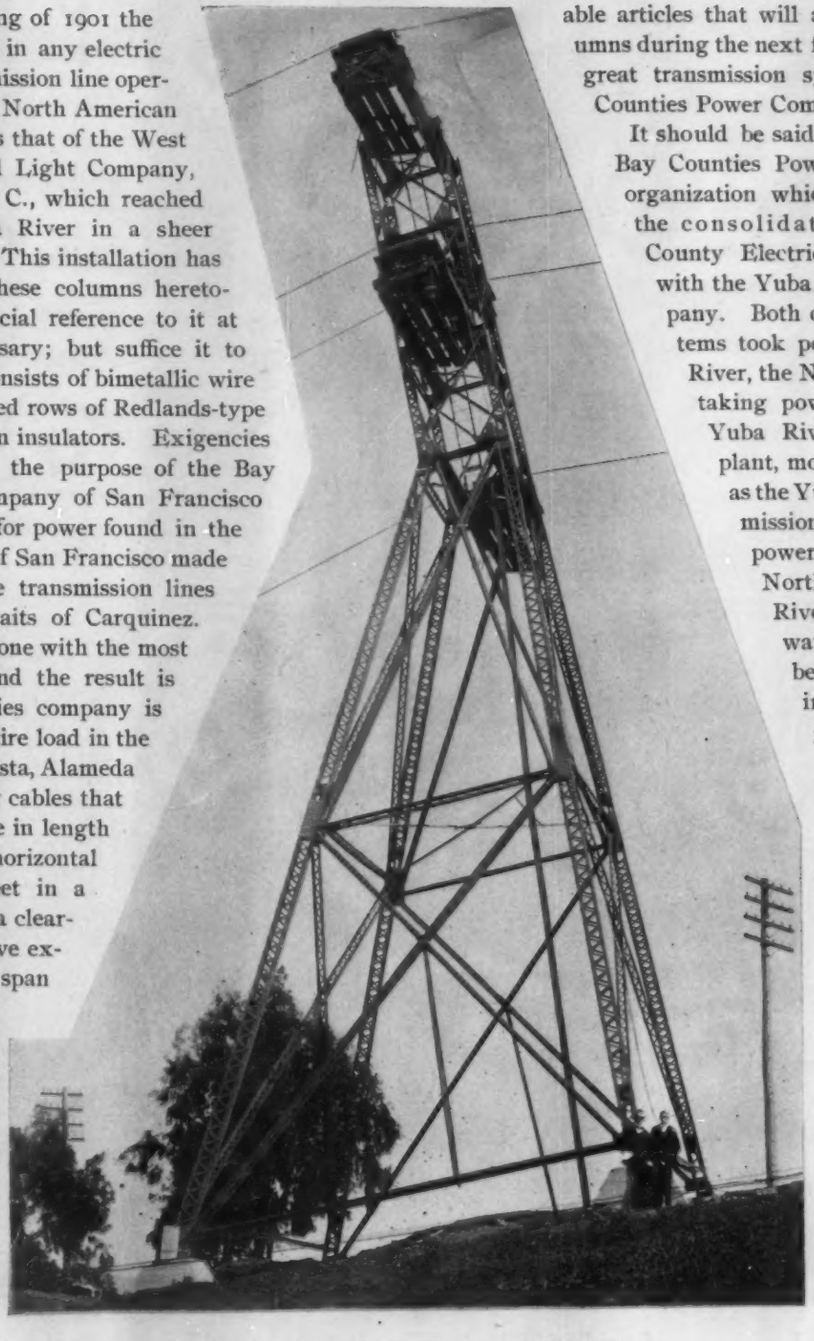
Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XI. SAN FRANCISCO, MAY, 1901. NUMBER 5.

The Great Carquinez Transmission Span.

BY GEO. P. LOW.

UNTIL the spring of 1901 the longest span in any electric power transmission line operating on the North American continent was that of the West Kootenay Power and Light Company, Ltd., of Rossland, B. C., which reached across the Columbia River in a sheer stretch of 1500 feet. This installation has been described in these columns heretofore,* hence any special reference to it at this time is unnecessary; but suffice it to state that the span consists of bimetallic wire supported on reinforced rows of Redlands-type high-tension porcelain insulators. Exigencies that have arisen in the purpose of the Bay Counties Power Company of San Francisco to reach the market for power found in the cities about the bay of San Francisco made it necessary that the transmission lines should span the Straits of Carquinez. This has now been done with the most gratifying success and the result is that the Bay Counties company is now operating its entire load in the counties of Contra Costa, Alameda and Santa Clara over cables that are in excess of a mile in length and which cover the horizontal distance of 4427 feet in a single span that has a clearance of 206 feet above extreme high tide. The span forms a most noteworthy engineering achievement in both a mechanical and an electrical engineering sense, and as such, a description of it will form a fitting introduction to the series of invaluable articles that will appear in these columns during the next few months upon the great transmission system of the Bay Counties Power Company.



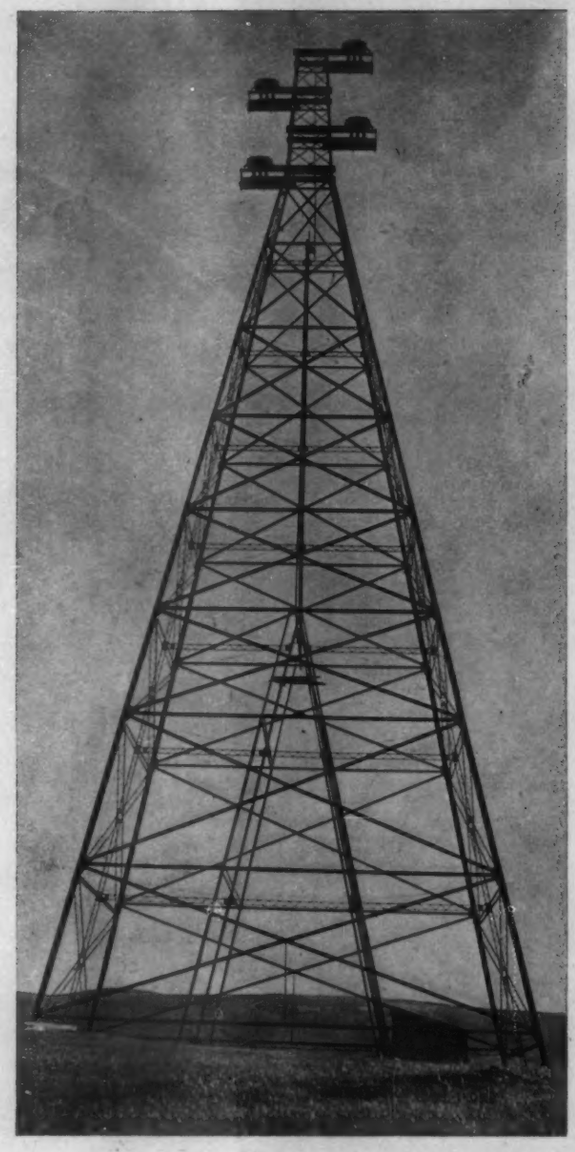
A SIDE VIEW OF THE LEANING, OR NORTH, TOWER.

It should be said in passing that the Bay Counties Power Company is the organization which resulted from the consolidation of the Nevada County Electric Power Company with the Yuba Electric Power Company. Both of these original systems took power from the Yuba River, the Nevada county plant* taking power from the South Yuba River while the Yuba plant, more commonly known as the Yuba-Marysville transmission,† was operated by power derived from the North Fork of the Yuba River; and it is this Yuba water right which has been developed by the installation of the great power house at Colgate which contains about 18,000 horsepower. These three power houses are of course operated conjointly and deliver power to transmission lines that are operating in sixteen counties in the state of California, ranging in applications from gold dredging on the Feather River near Oroville, on the north, to cus-

*THE JOURNAL, Vol. VII, page 754, May 1899.

*THE JOURNAL, Vol. I, page 107, November, 1895.

†*Ib.* Vol. V, page 145, May, 1898.

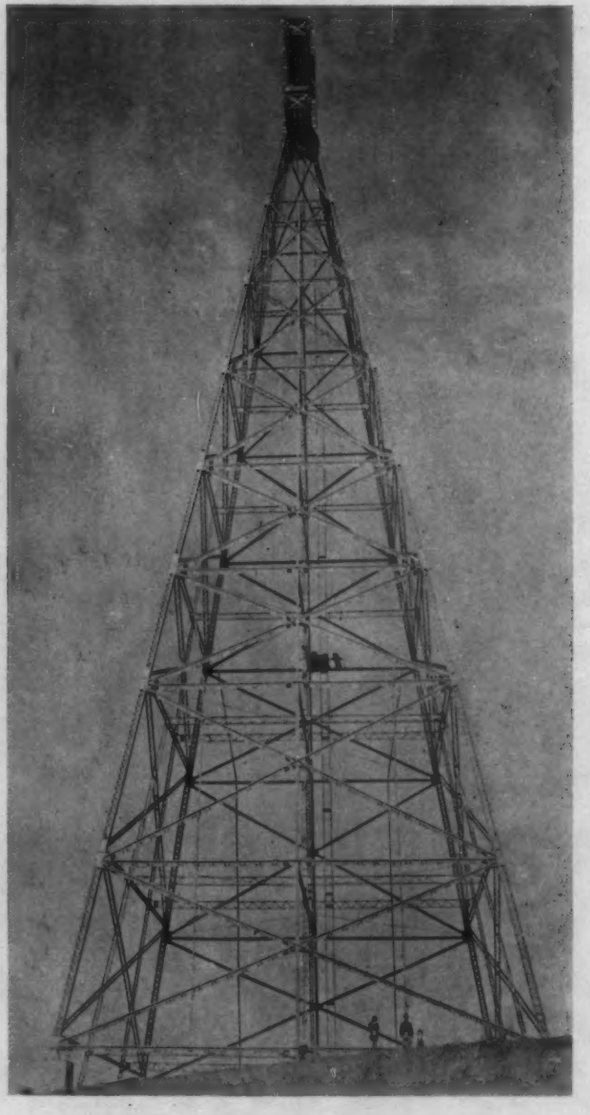


FRONT VIEW OF THE MAIN TOWER.

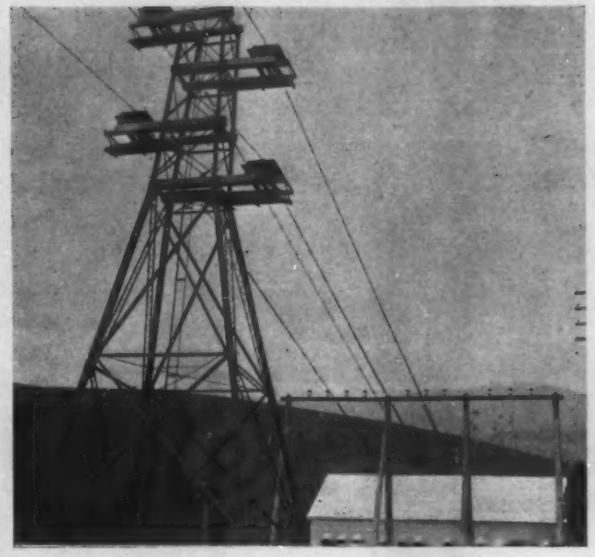
tomary commercial uses in and about San Jose on the south—a maximum distance, by way of the pole line, of 182 miles from the Colgate power house.

Today the system of the Bay Counties Power Company constitutes the embodiment of some of the most noteworthy engineering achievements ever accomplished. Its voltage is the highest in commercial use, despite which it is safe to predict that within a year its transmission potentials will be increased from 25 per cent. to even 50 per cent.; its length of transmission line is almost double that of the longest previously used; its generators are the largest horizontal shaft machines used by any water power plant in the world; its water wheels are of a greater capacity than any other wheels of the tangential type used in the world; and its entire system from one end to the other is, in truth, of the same heroic trend that is characteristic of the span which marks the crossing of its lines over the Straits of Carquinez.—THE EDITOR.

THE Straits of Carquinez is a comparatively narrow waterway separating Solano and Contra Costa counties, of California, and connecting San Pablo and Suisun Bays, which together form the northerly extremity of San Francisco Bay. A glance at the map will show the situation clearly, and also show the fact that practically the entire central portion of the state of California from the Siskiyous on the Oregon boundary to the Tehachipis which mark the dividing line between the portions of the state vaguely defined as central and southern California, on the south, is drained into the ocean through either the Sacramento or the San Joaquin Rivers into Suisun Bay, thence through the Straits of Carquinez and on to San Pablo Bay to the broad Pacific. At the point selected for the crossing the water is about 2750 feet wide with a depth ranging up to 120 feet, and through this narrow gap flow the waters of the rivers named as well as an ocean tide of about five feet, making at all times a heavy and dangerous current, which, though



SIDE VIEW OF THE MAIN TOWER.

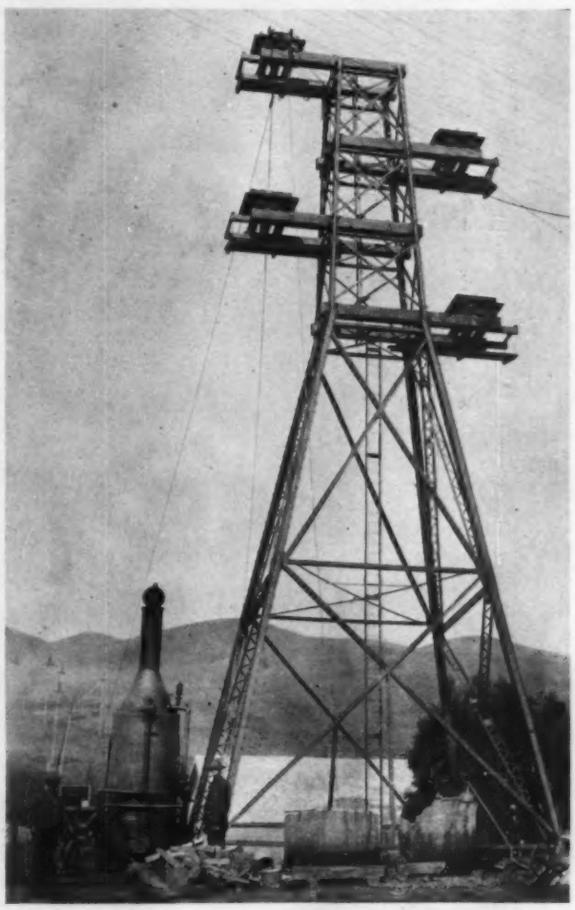


THE CABLES DROP TO THEIR ANCHORAGES BEHIND THE NORTH TOWER SUBSTATION.

not so strong as to prevent the laying and operation of telegraph and telephone cables, is sufficiently so that it makes their maintenance a serious item and utterly precludes any possibility of laying and operating high tension power submarine cables. Of course the laying of such cables was considered very carefully, but the strength of the current in the channel together with the rocky character of its bottom and the impossibility of constructing heavy high tension cables that would operate at 60,000 volts and give assurance of withstanding the abrasion of the channel, soon led to the conviction that the only possibility of crossing the straits was to be found in the aerial method.

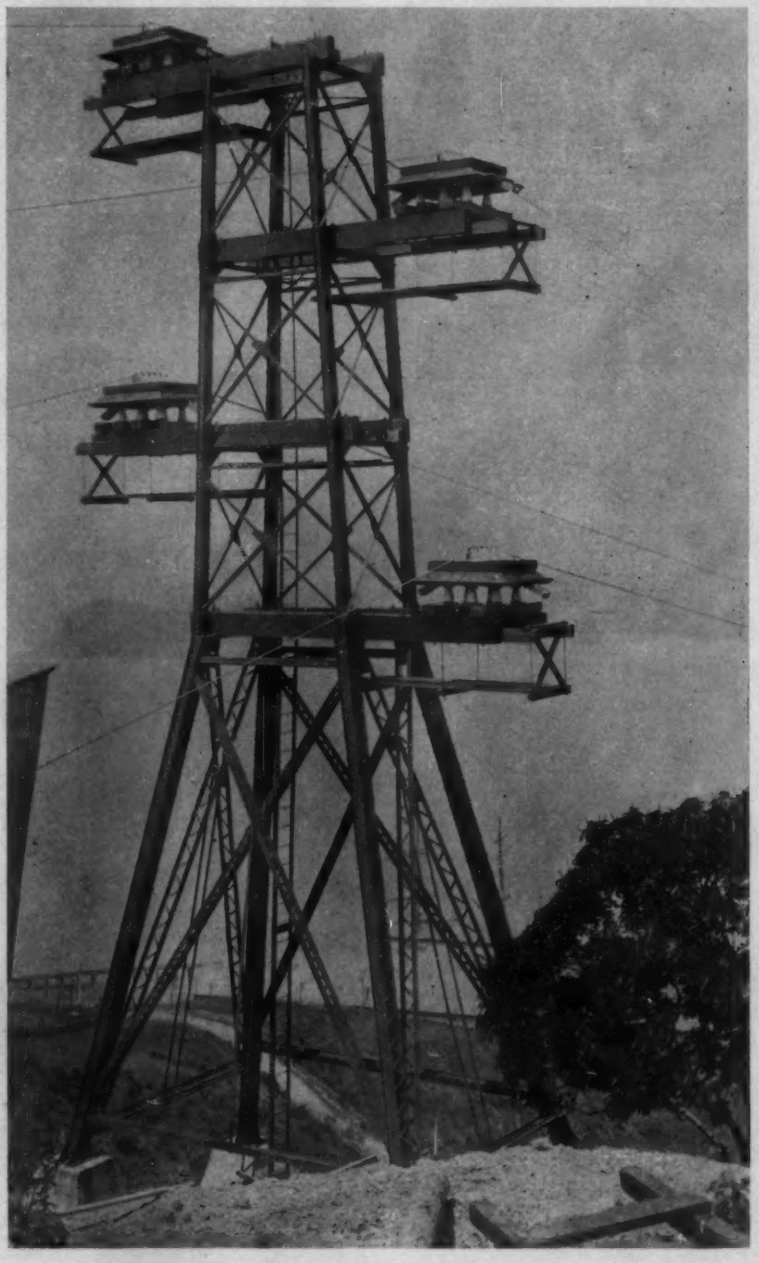
A survey of the conditions showed the waterway to be of the width and depth indicated, and that a bluff known as Dillon's Point existed on the north or Solano side of the straits, rising to a height of 162 feet above extreme high tide. On the south, or Eckley side, in Contra Costa county, exists a hill rising about 100 feet from the water's edge, whence it continues to rise in a general incline until, when perhaps half a mile back, an elevation of 400 feet has been reached. In front of this 100-foot bluff is the main line of the Southern Pacific railroad running from Port Costa to Oakland, along which, at Eckley, are numerous telegraph and telephone lines, a hotel, warehouse buildings and other houses constituting the settlement. Within a radius of a mile or so along the water front are the sugar refineries at Crockett, the smelters at Selby, and the enormous warehouses at Port Costa and vicinity which handle practically the entire grain output of the state for foreign shipment. Directly opposite, on the north side of the straits, where Dillon's Point is located, is found the southerly portion of Mare Island where the United States Navy Yard harbors the Pacific squadron. The Carquinez span reaches from the 400-foot elevation back of Eckley, across to Dillon's Point, passing directly over Eckley. The United States Government, in granting permission to cross at this point, stipulated that a clear headroom of at least 200 feet should be allowed for vessels; the Shenandoah, the largest vessel of the American merchant marine, has a height of 214 feet from keelson to peak, or a height of, say, 194 feet above the waterline.

To meet all requirements it was finally decided to erect a steel tower 225 feet in height at a suitable position on Dillon's Point, and another steel tower 64 feet high back of Eckley on the south side at the 400-foot elevation referred to. These two towers are known as the "main" and "south" towers respectively, and the horizontal distance between their perpendiculars is 4427 feet. It must be borne in mind, in endeavoring to understand the reasons which led to the adoption of the plan followed in erecting the span, that a minimum clearance of 200 feet had to be provided above the surface of the water; hence, in order to limit the height of the main tower to 225 feet, as was advisable, it was decided to so locate the south tower on the hillside that its top should be 80 feet higher than the top of the main tower, thus throwing the lowest point of sag in the span off the lineal center between the two towers; in fact, this lowest point is 2455 feet from the south tower and 1972 feet from the main tower, as shown in the drawing on page 100 presenting the profile of the crossing. A further reason for the arrangement adopted



FRONT VIEW OF THE LEANING TOWER.

is found in the fact that the land north of the main tower falls away to a marsh at near tide level, which made it necessary to turn the cables down to anchorages some 1700 feet back of the main tower. This condition compelled a great change in the dip of the cables between the main tower and the north anchorages, and necessitated the erection of the third or north tower, which, because of this change in direction of the cables, was built to lean toward the north. Its inclination is at an angle of 13 degrees from the perpendicular, and this has led to its being known as the "leaning" tower, although the company terms it the "north" tower.



THE SOUTH TOWER, AS SEEN FROM THE SOUTH TOWER SUBSTATION.

The three towers are of steel and iron throughout with the exception of the main cross-arms supporting the cable saddles, which were of course designed to afford an insulating support for the cables. The principal interest in the strains and stresses to which these structures are subjected centers in the main tower, wherein compression and tension strains were thus determined: Assuming that the maximum pressure exerted by the wind will be 40 pounds per square inch, the maximum strains of compression upon each of the four corner posts of the main tower are:

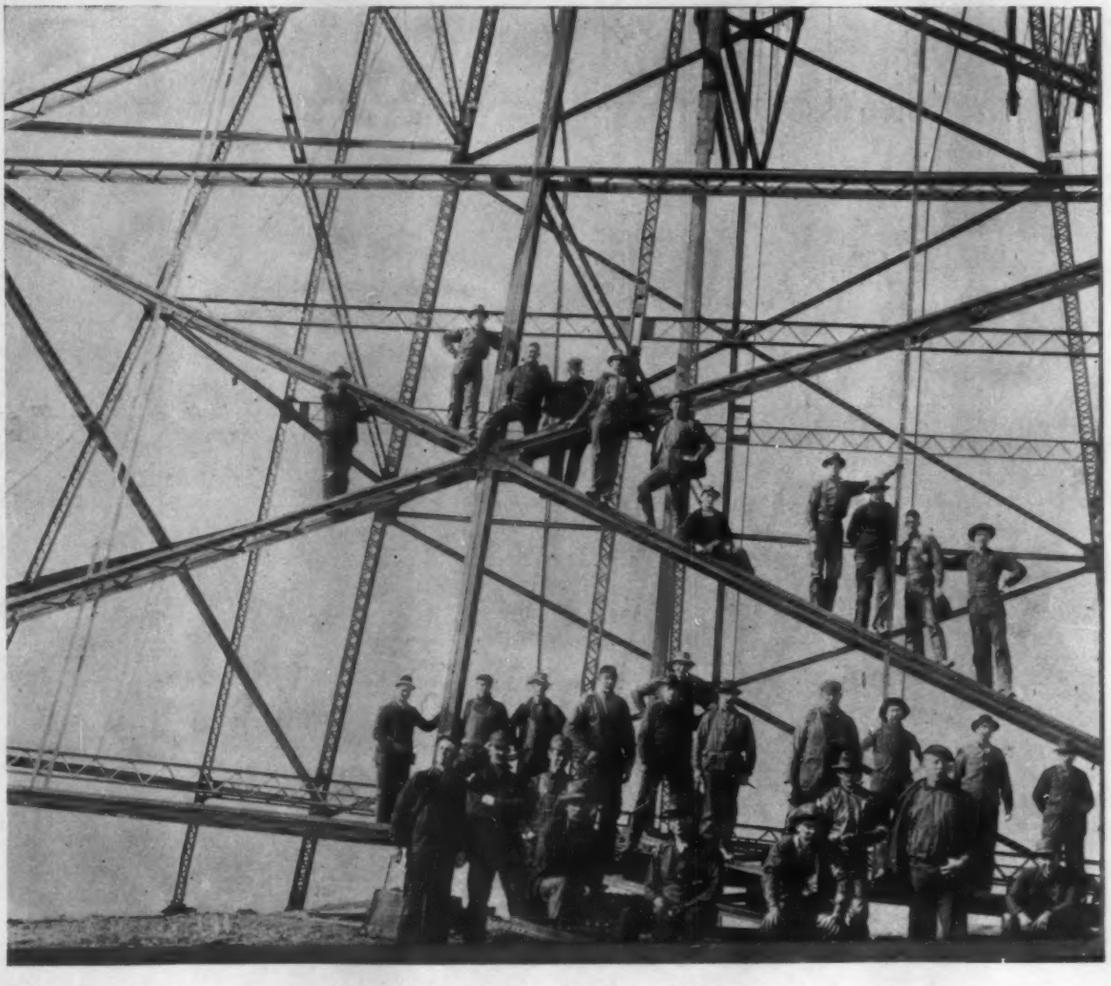
Wind strains	76,500 lbs.
Live load	6,000 "
Dead load	50,010 "
Maximum compression strains	132,510 lbs.

On the other hand, the theoretical maximum tension strains amount in the aggregate to 9400 pounds, while the practical maximum allowed is 17,600 pounds, affording an ample factor of safety.

Twelve concrete piers with the corner ones arranged in a quadrangle measuring 69 feet by 89 feet between the pier centers, support the main tower, and these four main or corner piers are cubes of concrete having eight-foot sides. Bedrock is close to the surface on Dillon's Point, hence these piers are designed more to give weight as anchorages than to serve as foundations; or to express the idea in other words the concrete blocks are of greater utility for the weight they possess than for their serviceability as supports, although both are important. The two smaller towers are each supported on four piers, also of concrete, those of the south tower forming the corners of a quadrangle measuring 16x20 feet on the pier centers, while those of the leaning tower measure 31x28 feet on the pier centers.

If the structures are viewed from their electrical standpoints, the greatest interest will be attached to the means for supporting the cables from the towers and for insulating them from their anchorages—for it must be borne in mind that the cables themselves carry 40,000 volts, and that this pressure will soon be raised to 60,000 volts. Beyond this, when it is remembered that each cable exerts a pull of twelve tons on its anchorages, the fact will at once be appreciated that the problem of securing adequate insulation, coupled with sufficient mechanical strength, was by no means one of easy solution. The headwork, or cable supporting methods of the three towers, are identical in design, dimensions and materials. On page 96 is presented drawings giving the essential features of this very interesting piece of construction. The timbers shown thereon

are of Oregon pine thoroughly kiln-dried, puttied and then given two coats of oil, after which they are covered with two coats of the best spar varnish. Two main cross-arms, each 17 feet 8 inches long by 7¾ inches thick by 15¾ inches deep, support three 7¾x9¾x6-foot cross timbers upon each of which are mounted the two steel insulator pins that in turn carry the great porcelain insulators shown in the drawing. These insulators were made by Fred M. Locke, Victor, N. Y., and weigh approximately 50 pounds each and those installed withstood long continued tests of 120,000 volts; but some of them, such as

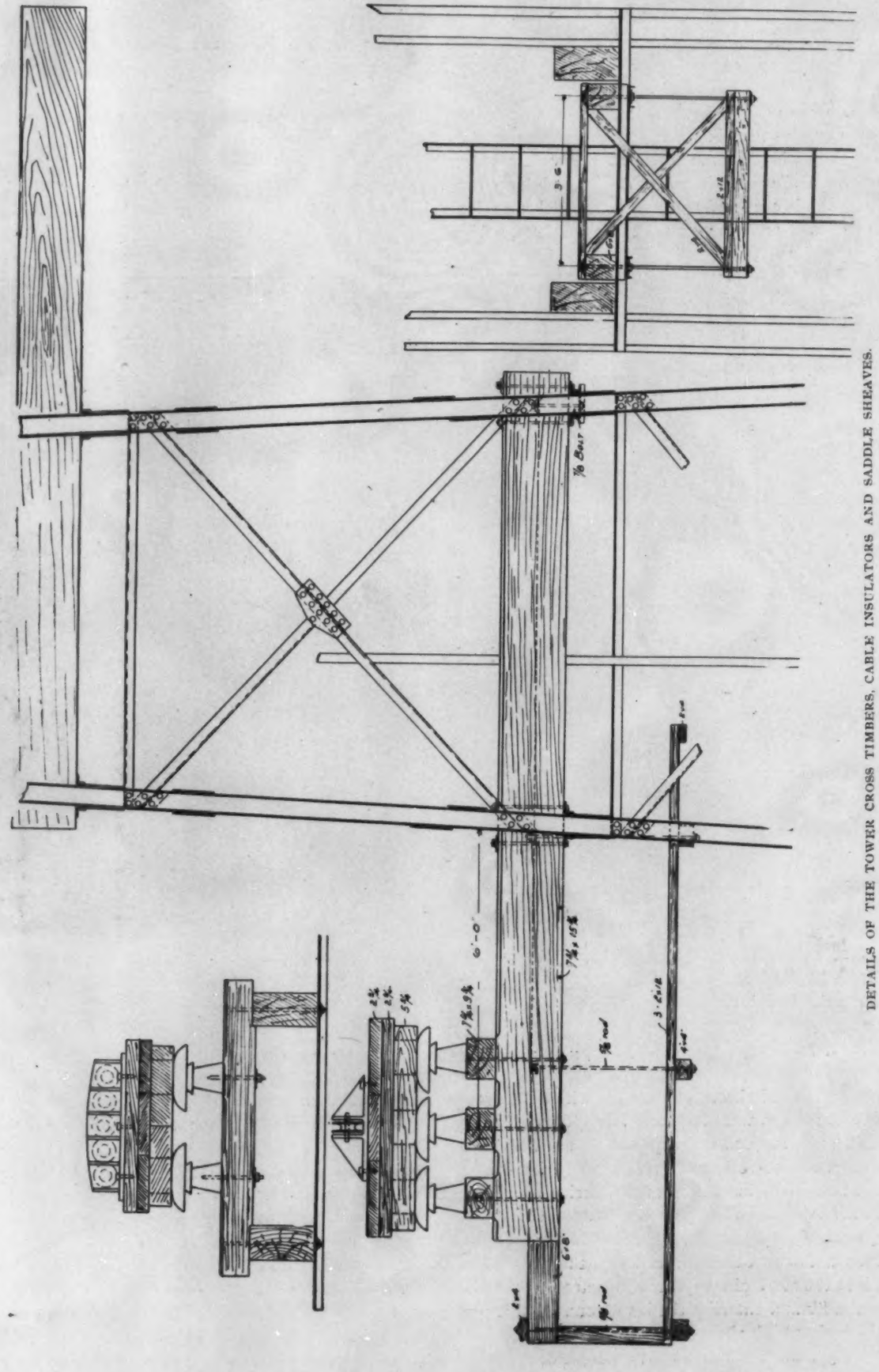


THE MEN WHO BUILT THE MAIN TOWER

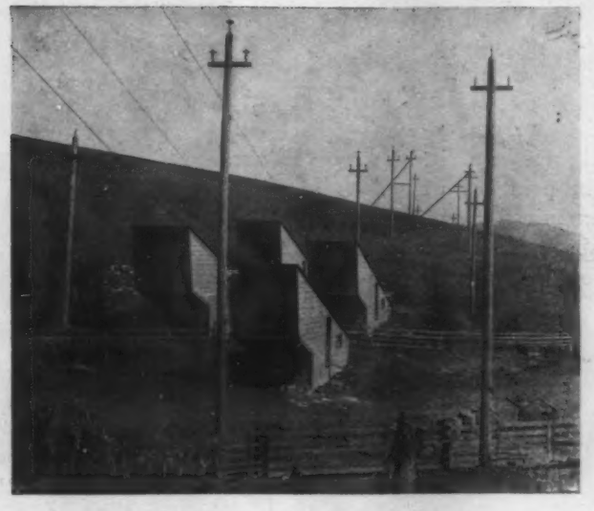
the one shown in the halftone on page 97, which illustrates the method of testing, were less fortunate and were broken down. A test of 120,000 volts applied to an insulator to be used on a 60,000-volt line, gives a safety factor of 4, for inasmuch as two insulators are in series across the line, each is subjected to but 30,000 volts.

Reverting again to the drawing, the steel pins referred to above are not shown therein, although the bolts which enter up into the steel pin appear as penetrating the six-foot cross timber and entering the insulators. These pins stand 14 11/16 inches high above their cross-arms, their cone has a base of 5⅜ inches in diameter, a height of 11 inches and a top 2 inches in diameter, while the remaining 3 11/16 of the total height of the pin is cylindrical in shape, 2 inches in diameter, and cut with a standard thread to carry the great insulator. Steel bolts, 13 inches long by 1⅜ inches in diameter hold the pins to their cross-arms, the bolts being drawn up by nuts placed under 4½-inch washers and held by check-nuts. There are six insulators to each cable saddle, and the head of each insulator is countersunk into the timbers forming the upper platform—all these upper platform timbers, by the way, being boiled in paraffine. Above the countersunk timbers, which are two in number, each measuring 4 feet 2 inches by 1 foot 8 inches, are placed two courses each consisting of three 2¾-inch by 4-feet 6-inch planks. The whole upper platform is covered with the heaviest canvas and well painted with P & B paint, and wooden spouts, not shown in the drawing, are provided for carrying rainwater well away from the insulators.

The cable saddle is mounted directly upon this upper platform, being secured thereto by six bolts which do not go through the upper course of planking. These saddles are of galvanized cast-iron measuring 3 feet by 2 feet 2 inches, with an extreme height of 9 inches. A longitu-



DETAILS OF THE TOWER CROSS TIMBERS, CABLE INSULATORS AND SADDLE SHEAVES.

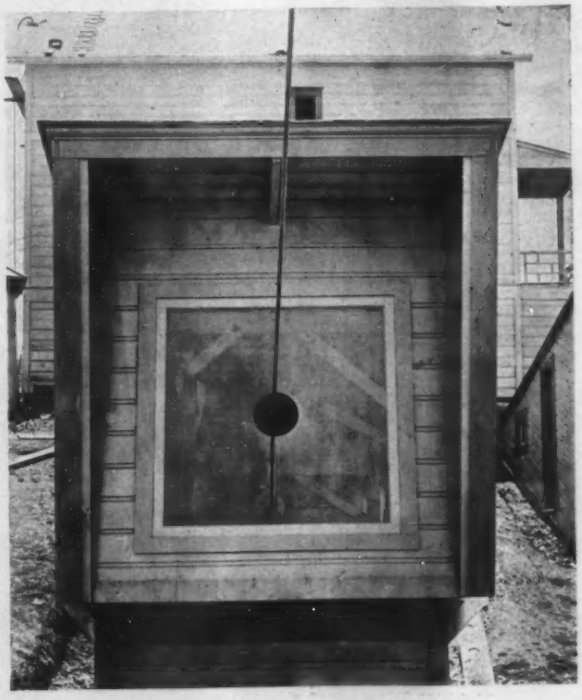


THE FOUR ANCHORAGES BEHIND THE LEANING TOWER.

dinal channel 3 inches wide with walls each braced by six ⅝-inch ribs, is cast into the saddle base, and in this channel are placed five cast-iron sheaves supported on 1⅛-inch steel pinions the centers of which pinions are on an arc with an 8-foot radius. These sheaves have a diameter of 5⅞ inches by an extreme width of 3 inches, and they are galvanized—as in fact are all cast-iron pieces exposed to the weather.

An extreme variation in temperature of 60° F. may possibly occur at Carquinez, which would cause a variation of 5 feet in the sag and which in turn would cause a travel of approximately two inches to occur in the cables running over the sheaves of the main tower.

Individual anchorages, well separated, are provided for each cable, and they consist of masses of concrete, each having a base 9 by 10 feet and being 5 feet high, set into the bedrock in the manner shown in the drawing on page 103. Embedded in the concrete blocks are crossed channels and plates from which extend steel eyebolts with pin connections, first, to two sets of steel car springs, then a turnbuckle, then two tandem yokes connecting with heavy micanite insulators in copper cases containing transformer oil; and lastly, a 24-inch sheave around which the cable is turned and secured with clamps and clips.



HOW THE CABLES ENTER THEIR ANCHORAGES.

A SADDLE INSULATOR UNDER TEST.

Outlines of the above are given in the drawing last referred to.

As with the saddles, all iron parts of the anchorages are galvanized, and the entire work is characterized by the utmost stability and thoroughness. Some idea of the character and dimensions of the strain insulators used will be obtained from a description of the stirrups and rings which support them. Each stirrup is made of a wrought-iron bar 1½ inches square forged into the shape shown in the drawing giving the general design of the connection details of the anchorages. The width of the stirrup in the clear is 13 inches, and its length from yoke to foot is 40 inches. Upon the tread or foot of the stirrup is placed a cast-iron ring 10½ inches in outside diameter by an inside diameter of 6 inches with a length of 5 inches. Holes 1¾ inches square by ¾ inch deep are cast in dia-

metrically opposite points to give footing for the treads of the stirrups, and on the opposite or upper side of the ring is placed a micanite washer some 5 inches thick, with channels cut in its outer surface to increase the leakage surface. A final cast-iron washer with nut and check-nut completes the equipment with the exception that a copper tank filled with transformer oil encloses all, and a funnel-shaped porcelain placed as shown in the halftone on the next page gives added surface that tends to prevent leakage. Each anchorage is enclosed in an independent housing which is illustrated in exterior and interior views by the accompanying reproductions from photographs—the cable entering by way of a circular hole six inches in diameter cut through the center of the plate glass that is placed in the end of the housing. The cables are "dead-ended at the anchorages, and power is delivered to or taken from them by means of taps spliced on to them near the saddles of the north and south towers respectively. These taps come only from the substations at the two towers named, and of the four cables that have been erected, but three are ever in use at one time, the fourth being always held in reserve. Moreover, the cleaning, overhauling or repairing of all the cables in rotation is possible at any time when one is in reserve.

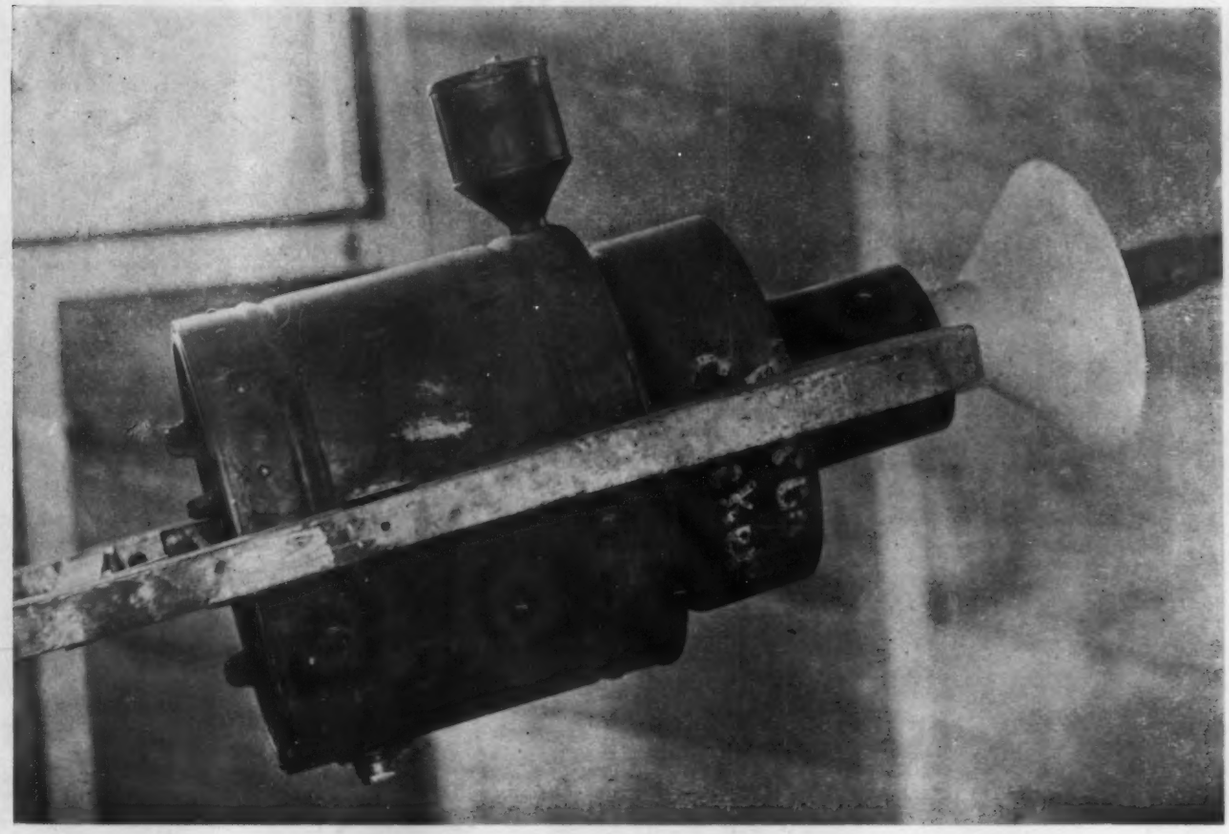
THE CABLE IS ANCHORED THROUGH TWO STRAIN INSULATORS PLACED IN TANDEM.

The cables are of solid plow steel with a solid steel core. There are 19 wires in the twisted stand, including the core, and the made-up diameter of the strand is seven-eighths of an inch. They are arranged in suspension on the points of a rhombus having 20-foot sides, and, when examined from the towers, their rigidity is apparently absolute. Again, when viewed from the tops of the towers, the sag in the span seems to be much greater than from a lower point of observation; in fact, it looks as though it had the catenary of a long jumping-rope. This sag is obviously much greater from the south tower than from the main tower, for the former is, as stated, 80 feet higher than the latter, and the sag from the two are therefore 227 feet and 147 feet respectively. It is of interest to note, by way of comment on the perfection of the insulation of the cables, that when the cables are dead and the wind is blowing from the proper quarter, the cables become charged with static electricity so that a spark having a length of one-quarter inch or more may be drawn from them.

It is something of a paradox that the cables move less on a windy day than on a perfectly quiet one. On a quiet morning one can put his hand on the cables, when no current is on, and feel a continuous jarring movement, but a little later in the day, when the afternoon breeze is blowing, he can take hold of the same cable and find it not only free from movement, but so absolutely rigid that if one imagines he can send a wave of motion out into the span by striking the cable a blow, he has but to try it to be convinced that it is immovable.

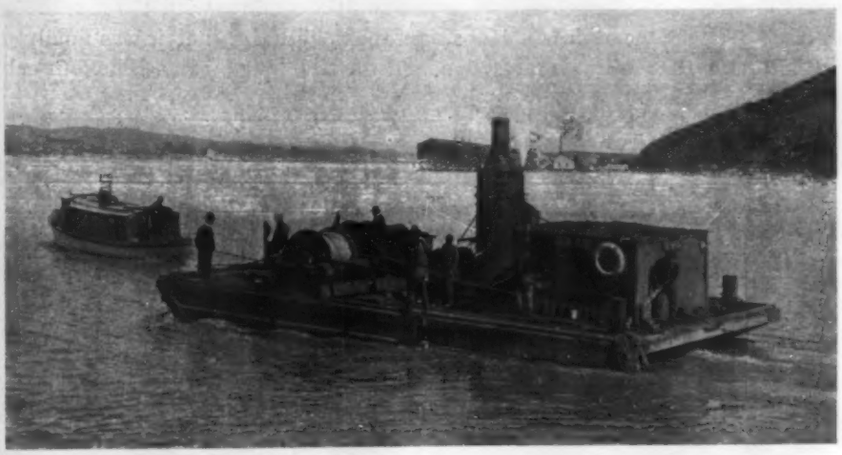
During the time in which they have been in service, they have been in operation at 40,000 volts with absolutely perfect success although subjected to one of the most severe storms that has ever been known to have occurred in their vicinity. The strain insulators were tested at 120,000 volts, and as two are used in series the factor of safety is 4 at a line potential of 60,000 volts.

Reverting again to the mechanical features of the span, it should be stated that the problem of erecting the cables to their positions in the span was one that called for con-



THE STIRRUP, THE OIL TANK AND THE PORCELAIN FLANGE OF THE STRAIN INSULATORS.

siderable study, but the method adopted by the Pacific Construction Company, which held the contract for the erection of the towers and crossing, was undoubtedly the best that could have been devised to satisfy the conditions and requirements of the work. The four cables, each of which was about 6400 feet long as stated, were horsed on a temporary wharf on the south shore where heavy bents were built over which to carry the cables clear of the various telegraph and telephone lines, railroad tracks and other obstructions at Eckley, and the ends were then hauled up to the south anchorage by windlass and secured to the anchorage system. The reels, one at a time, were then set on a frame that had been erected on a self-propelling steam barge, and wooden brakes were fixed to the reels and arranged so that the revolutions of the reels could be easily controlled during transit. This barge, augmented by a 50-horsepower gasoline launch, was thus towed across the straits paying the cable out as it went. Upon arriving at the north shore, the reel with the balance of the cable then remaining thereon was rolled ashore, horsed once more, and the rest of the cable was run off and coiled on the temporary wharf that had been provided for it. The donkey hoisting engine for pulling up the cables was located near the leaning tower, some 1800 feet distant from the landing, and was set to face the north anchorage. From the engine, and leading through a block at the anchorage and over both the leaning and main towers, was run a hemp line with which was pulled over the slack end of the cable. This hemp line pull brought the end of the cable near to the leaning tower, whereupon a steel line was attached for pulling the end of the cable over the leaning tower far enough to reach the end of the main pulling pennant used for the final pulls. The final pulls as well as the gear and takle are shown in detail in the drawing on



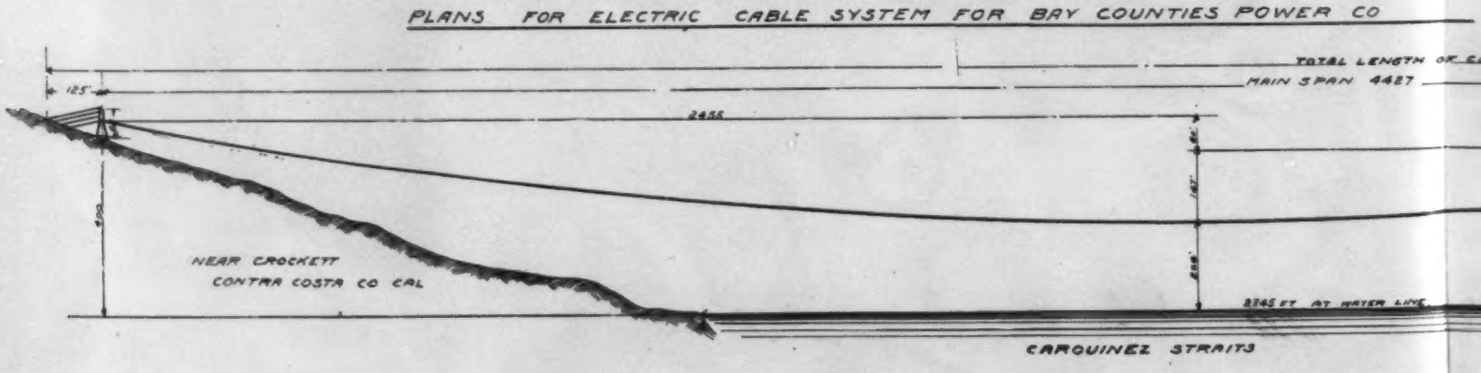
PAYING OUT CABLE FROM THE BARGE

L. of C.

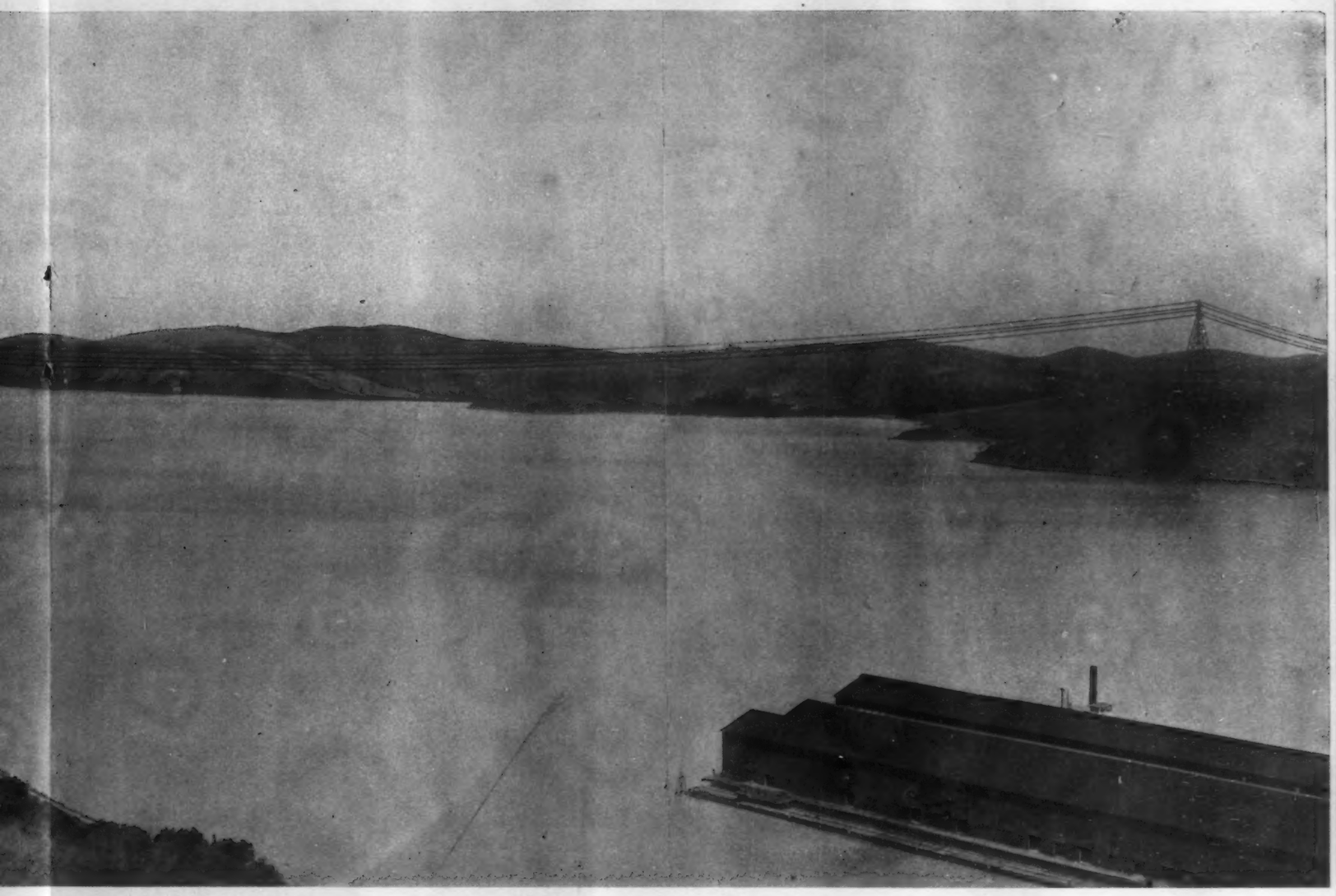
THE GREAT SPAN OF THE BAY COUNTIES POWER CO

page 102. In pulling up the cables, when the sag in the cable was such that it touched the surface of the water of the straits, its length between towers was 4535 feet and the strain was 9000 pounds; when the cable was 120 feet above the surface, the length was 4482 feet and the strain was 12,750 pounds, and in final position the length is 4448 feet and the strain is 22,500 pounds. The four cables, numbering them consectutively from the topmost down, are at elevations of 236, 226, 216 and 206 feet respectively above extreme high-water mark.

No special trouble was experienced in raising except with the first cable, which snagged near the south shore, but it was finally pulled off without having to be underrun. The four cables were raised in five days. Out here



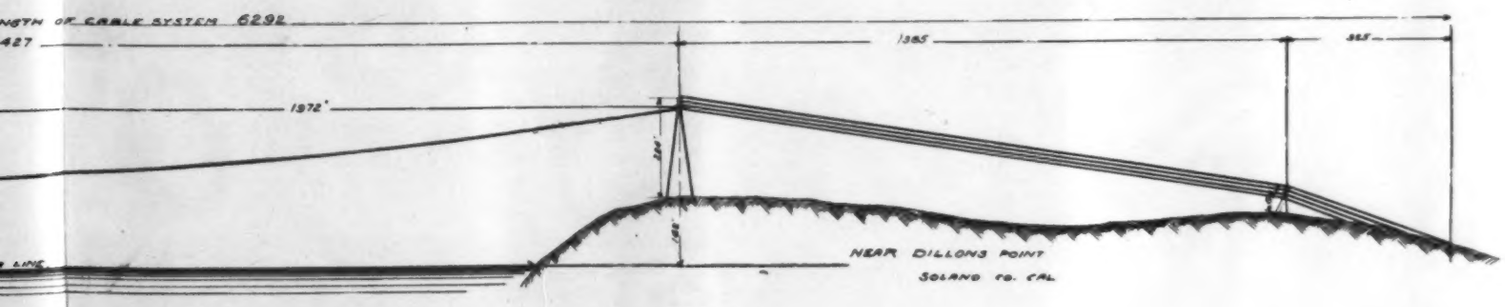
PROFILE OF THE CROSSING OF THE ELECTRIC CABLES OF THE BAY CO



POWER COMPANY CROSSING THE STRAITS OF CARQUINEZ.

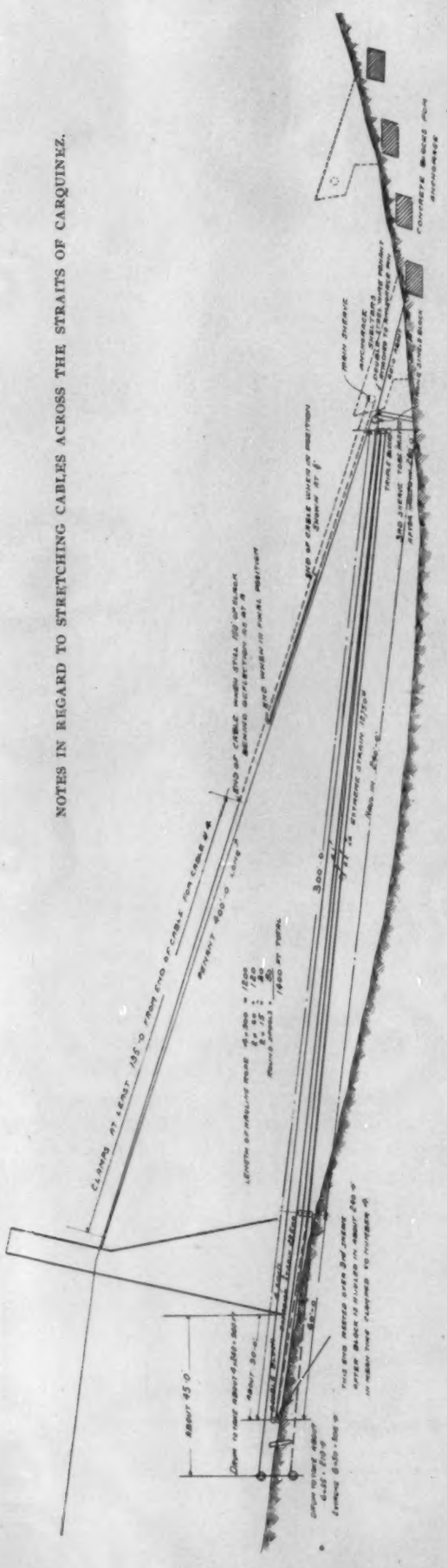
in the "Wild West" the government declines to give contractors the fostering care customary in the East and the company was required to provide its own patrol boats to keep boats and shipping out of the way. Fortunately, the raising of the crossing was not delayed by accident, and the patrol boats kept the "coast clear" without much trouble to anyone.

Owing to the high lands on both sides of the straits the span appears to approach the water much closer than it really does and the optical illusion is at all times most perplexing to mariners who first take their ships under the crossing. The story is told that while a big wheat freighter was being towed up to Port Costa early in April just after the second cable had been raised, her master

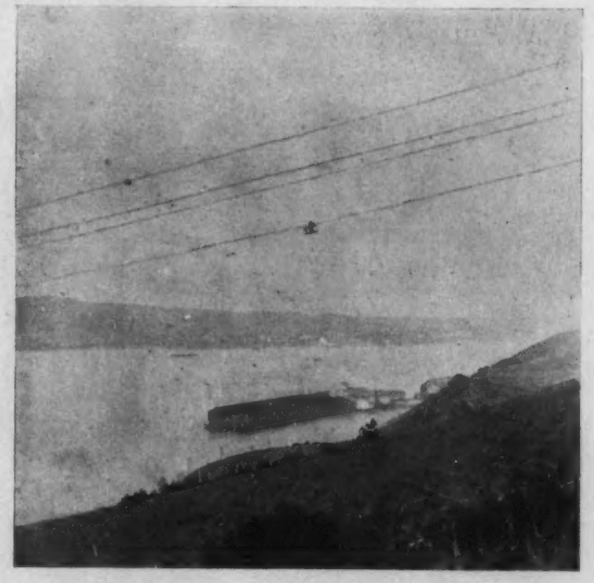


THE BAY COUNTIES POWER COMPANY ACROSS THE STRAITS OF CARQUINEZ.

NOTES IN REGARD TO STRETCHING CABLES ACROSS THE STRAITS OF CARQUINEZ.



and the captain of the tug were startled, as they neared Crockett, at observing two heavy wires spanning the straits and seeming to droop so low as to threaten destruction to the masts of the ship. The vessel's headway was checked and observations were taken, after which the tug and its tow moved forward very slowly and sought a pas-



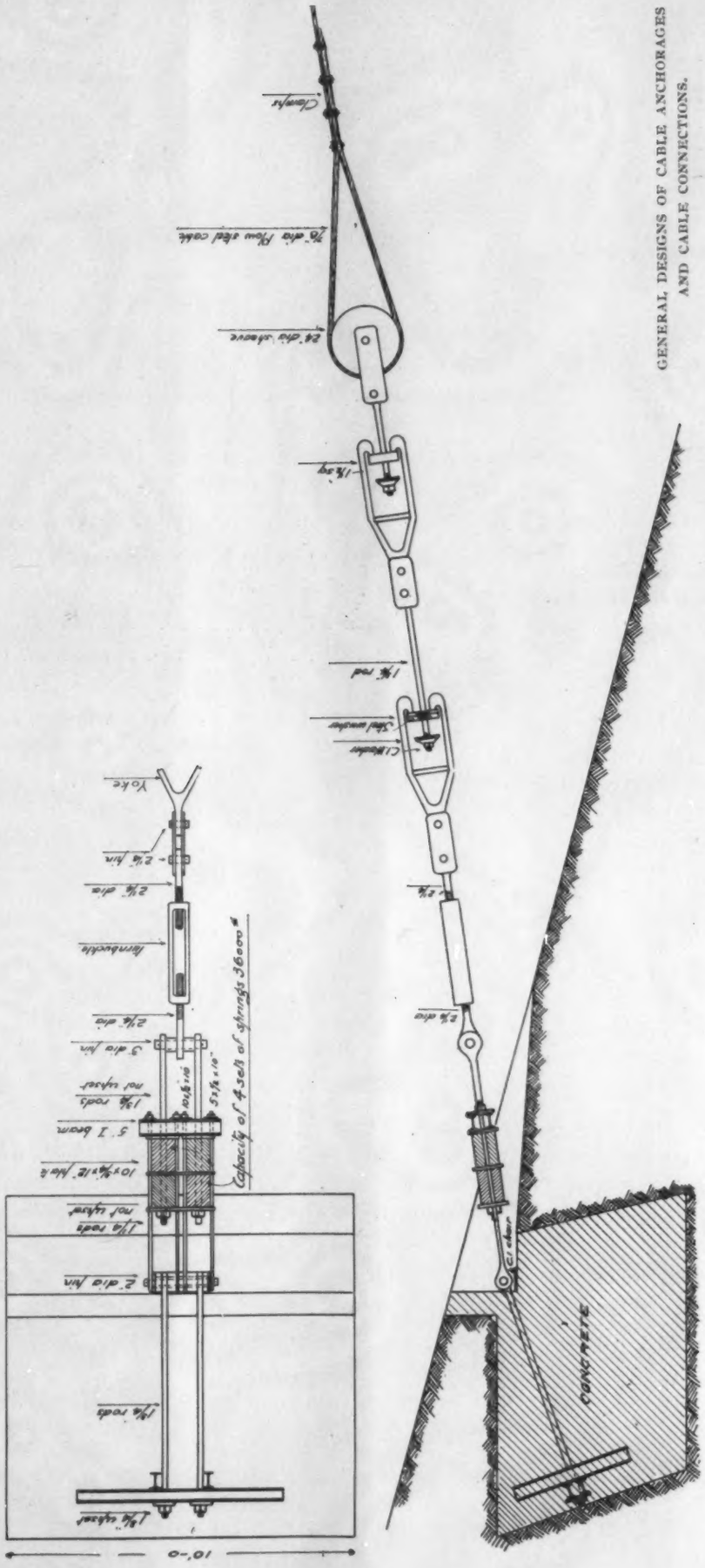
SEE THE MAN GREASING THE CABLES?

sageway near the northern side of the straits, where the wires were highest above the water. The ship's masts were 150 feet tall and when they passed under the wires they lacked another 150 feet of touching, although the captain had rather expected that his topmasts would come tumbling down, and the commander of the tug, who was giving an excursion to several ladies from San Francisco, sent them all down into the cabin to save them from being killed by the threatened falling spars and ship's rigging.

The plan of this most remarkable crossing, including the design of the towers and the mechanical features of the anchorage connections, as well as the plan for hoisting the cables, were all the work of the chief engineer of the Pacific Construction Company, Mr. F. A. Koetitz, and were approved by Mr. R. H. Sterling, superintendent of the Bay Counties Division of the Bay Counties Power Company, and Mr. J. D. Galloway, its consulting engineer. The erection of the span was done under the general direction of Mr. Koetitz and under the immediate supervision of Mr. F. M. Butler, secretary, and Mr. F. B. Field, general superintendent of the Pacific Construction Company. The electrical features of the crossing, including the saddle and strain insulators, were the especial design of Mr. Sterling.

The "no-slip" speed per second of an induction motor is found in the quotient of the frequency divided by one-half the number of its poles per phase; or, expressed in a formula:

$$\text{Revolutions per second} = \frac{2 \times \text{frequency}}{\text{Poles per phase}}.$$



GENERAL DESIGNS OF CABLE ANCHORAGES AND CABLE CONNECTIONS.

LIGHTNING ARRESTERS AND WIRELESS TELEGRAPHY.

BY C. W. HUTTON.

SOME time ago when wireless telegraphy first came into prominence, knowing where I could procure some of the necessary appliances, I concluded to experiment a little in that direction, merely as a matter of interest.

A six-inch Ruhmkorff coil for X-ray work was borrowed from a local physician, and the other instruments were kindly loaned by the manager of the Sacramento office of the Western Union Telegraph Company. We happened to set the coil up directly underneath a point where a large number of feeders for local distribution leave the substation building of the Sacramento Electric, Gas and Railway Company. A short piece of wire, about four feet long, was placed in an upright position and connected to one terminal of the coil, the other terminal being connected to the copper ribbon ground leading from the lightning arresters which were located directly under the feeders. The top of the upright wire was about fifteen feet below the feeders and set back about twenty feet from the wall on which the arresters were attached. The receiving apparatus was located about thirty feet away—as above stated I was only experimenting to demonstrate the theory.

Much to my surprise, with a $\frac{3}{4}$-inch gap between the balls on the coil, every time the coil was energized the lightning arresters on the 2000-volt circuits—which are of the standard General Electric make, with two air gaps of $\frac{1}{32}$-inch in series with a graphite resistance of 100 ohms—would snap just as if a discharge had come in on the lines.

Perhaps it was an answer from Mars, but I could not "get onto his curves."

THE WELSBACH INCANDESCENT ELECTRIC LAMP.

AUER VON WELSBACH'S new osmium incandescent electric lamp is reported by an English gas contemporary* to consume as now made 1.71 watts per English standard candlepower, and to last from 700 to 1200 hours. A specimen used 1.65 watts per standard candle at first, and 1.94 watts after 1500 hours, at which period it was intact. The lamps, it seems, can be readily repaired if the filament be not broken.

The voltage required for the operation of these lamps varies between 25 and 50, and at a demonstration given to the stockholders of the German Welsbach Company, a series of four of the new incandescent electric lamps consumed 0.96 amperes at 100 volts. The candlepower of the lamps used is not stated.

*The Gas World, Volume XXXIV, page 437, March 23, 1901.

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Devoted to the Conversion, Transmission, and Distribution of Energy.

Conducted by GEO. P. LOW.

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VOLUME XI MAY, 1901 NUMBER 5

EDITORIAL.

TO MEET AT SAN JOSE.

Announcement has been issued to the effect that the Fifth Annual Convention of the Pacific Coast Electric Transmission Association will be held in the Assembly Room of Hotel Vendome, in San Jose, on Tuesday and Wednesday, June 18th and 19th, where delightful surroundings and perfect service give fullest warrant that the social side of the convention will be far more enjoyable than any heretofore held. Of much greater consequence, however, is the assurance which is extended that the subjects of the papers to be brought for discussion before the convention are most timely and fully up to the standard that will preserve for the Association its dignity as representative of the corporations that are leading the engineering world in the electrical transmission of power. Mr. Lewis A. Hicks, who is foremost among American irrigation engineers, will present a paper upon the possibilities and limitations of electrically transmitted power in driving pumps for irrigation duty, and Mr. Theodore E. Theberath, one of the electrical engineers of the Bay Counties Power Company, will discuss the phenomena attending the use of telephone circuits when operated over wires placed on high tension transmission pole lines, and pointing out the causes of trouble in such telephone circuits as well as methods of their elimination. Not less noteworthy will be papers presented upon high tension switching and fusing devices in modern transmission work, upon important features of construction in extremely heavy, long distance, and high tension electric power transmission pole line work, and upon other equally interesting and vital subjects.

Inasmuch as San Jose at present forms the terminus of the extraordinary transmission line which, through the agencies of the Bay Counties Power Company's lines from the North Yuba River to Oakland, thence by way of the Standard Electric Company's line to San Jose, delivers power for the operation of the electrical industries of the Garden City over a 40,000-volt circuit that is 184 miles long, it is fitting that the convention should be held there. The mere mention of this fact indicates at once to the engineer the invaluable opportunity that is afforded for an intimate study attending the behavior of transmission lines that are of such voltage and such length as make them truly remarkable engineering triumphs. It may be stated that the engineer will find that his most sanguine expectations will be gratified in the actual, practical demonstration that awaits him, and he will be brought to the further realization that the experience he will gain by attending the Convention will be the most valuable that could be conceived.

The Convention will open at 1:30 o'clock on the afternoon of the first day, and parties who attend from San Francisco are requested to take the train leaving Third and Townsend streets at 9 a. m., on Tuesday, June 18. Here should be noted an innovation in reference to transportation to the Convention. The Southern Pacific Company has consented to allow a one and one-third rate—that is, the fare one way, plus one-third of the fare one way—for the round trip to San Jose from all points in California, provided not less than fifty first class tickets are purchased by persons in attendance to the Convention. Under this plan a certificate is issued to the delegates to the Convention by the railroad agent at the point where the ticket to San Jose is bought. When you buy your ticket to San Jose state to the agent that you are going there to attend the Convention of the Pacific Coast Electric Transmission Association, and ask him to give you a certificate to the effect that you have bought a full price first-class ticket. The Secretary of the Convention will vise your certificate to the effect that you are one of fifty attendants holding such certificates, and you will then be able to buy a return ticket to your home at one-third the regular first-class rate. You are urged to avail yourself of this plan, for even though the difference saved in your case may be trifling, your certificate will count for the benefit of those who travel by a longer haul and a more expensive fare.

On Tuesday afternoon the Convention will partake of the hospitality of the Electric Improvement Company of

San Jose, which will provide a special train for the conveyance of its guests to Alum Rock, where luncheon will be served. The ride will be noteworthy from an engineering standpoint in that part of it will be over an electric road driven by the waterpower plant at Colgate, 184 miles distant, after which a visit will be made to the new station of the Electric Improvement Company, which embodies the latest and best practices in the combination of steam-driven polyphase with storage battery and long distance transmission work. As usual, the banquet will be held on the evening of the first day and the function will be along a new line in that the ladies of the Convention will attend.

A DEAD AND BURIED OLD MAN OF THE SEA.

Ever since water power at high head has been applied to the driving of alternating current generators for purposes of long distance transmissions, the minds of engineers have failed to be in common accord as to the method which would afford the greatest immunity from difficulties that were seemingly inherent to exciters. Though these machines are almost insignificant in point of size to the generators which they imbue with life, they are, as all will grant, the very vitals of modern transmission practice, and as such their management, especially in points of continuity, reliability and steadiness of service, has always been a problem of difficult solution. And even now only can it be said the final solution has at last been reached.

Consider if you will that the exciter is the heart of the generator; that it is the engine which pumps the direct current of life into the veins of the greater dynamo, in response to which it springs into its work of converting mechanical into electrical energy. When the heart is affected the whole system is affected, and heretofore the heart of generating stations has been a rather weak member for reasons that are various, although all of them are traceable back to the common cause, namely, that of their driving. The exciters themselves are thoroughly reliable machines, but the difficulty with them has been that to drive them by direct connection from tangential water wheels operating under high head necessitates the use of nozzles of such small diameters that they easily choke from the slightest obstructions, such as twigs or pebbles or leaves, that may be taken down the pipe line. If, on the other hand, the exciters be driven by belting from the shaft of the main generator, then each exciter is not only exposed to all the ills to which belting is heir—and generally belting is of hide which was originally very close to flesh, hence its ills must be many—but it is also afflicted with the contagion of speed fluctuations which varying loads impose upon the generator entailing magnified fluctuations in the exciter voltage. These conditions indicate the reasons why the exciter has become to be regarded as a very evil necessity, but necessary it is nevertheless, although it is safe to say that it has now been shorn of its evil proclivities.

The problem of exciter design and operation was given very careful consideration by the builders of the great Colgate powerhouse of the Bay Counties Power Company, and the plan finally adopted, which was that suggested by Mr. T. E. Theberath, was this: A fifty horsepower tangential waterwheel carries a fifty horsepower exciter coupled direct on one side, while on the other side is a fifty horsepower induction motor. This motor is run directly on the main station busbars, which are, of course, in parallel with the 2400-volt generators. The exciter waterwheel is run "wide open" at all times regardless of the load upon the exciter, which, by the way, delivers current for the excitation of either one or two 2000 kilowatt generators as circumstances may require. Under these conditions, fifty horsepower in energy must go into the combination at all times, for that is the power delivered to the set by the waterwheel. If now, the exciter is delivering current for the excitation of one 2000-kilowatt generator, or say twenty-five horsepower, the remaining twenty-five horsepower developed by the waterwheel goes into the induction motor which acts as a generator by delivering the energy put into its shaft, into electrical energy which goes to the main busbars. When the second generator is thrown in service, the load on the exciter is increased to say fifty horsepower, the speed of the set drops slightly, the induction motor ceases to act as a generator and simply balances on the busbars, just as a storage battery is kept floating on a street railway or lighting system, giving or taking current as the exigencies of service may demand. So the induction motor gives or takes power from the main busbars according to the load being carried by the exciter, or to the amount of power being delivered by the waterwheel, or both, and as such it is a superlative regulator. Thus at times, the waterwheel will be delivering electric power from both exciter and motor; at other times the exciter will be absorbing all its power and the motor will be running idly, while at still other times the motor will be pulling both the exciter and the waterwheel—as will occur by the choking of the waterwheel jet. The combination has already demonstrated its worth at Colgate, for one day the nozzle of the exciter wheel became clogged, whereupon the induction motor picked up the exciter and carried its load without interruption to the service; in fact, the change was not noticed until a station attendant chanced to see that the induction motor was pulling its full load amperes.

It is not appreciated as it should be that the induction motor is a remarkably serviceable and efficient machine when run as a generator. Its characteristics as a generator are practically the same as they are in the machine as a motor. Of course the machine must be supplied with magnetizing current, when it is to be run

as a generator just as it is when run as a motor. The value of the magnetizing current in induction motor generators of different capacities has not been stated, but an experiment performed at Colgate indicates that it is small—"just enough to tickle the motor a little bit," as one of the station attendants described it. The exciter set was started up together with one of the 2000-kilowatt Stanley inductor three phase generators, and after the latter had been brought up to speed the water was shut off from its wheels and it was allowed to run of its own momentum. It takes some twenty minutes for the inductor of one of these big generators to come to a standstill, and in this time ample opportunity was given to experiment with the exciter set. With the gate of the exciter wheel open and the inductor of the big generator revolving of its own momentum, the waterwheel of the exciter furnished the excitation for the generator fields, the big generator supplied the magnetizing current to the induction motor acting as a generator, and the output of the latter was absorbed by the armature of the big generator, tending to cause the latter to run as a motor. The effort exerted in the latter direction was inappreciable, however, but it was very noticeable that as the inductor speed and consequently the generator voltage dropped, the ampere output of the induction motor increased until two and almost three times the full load current was reached—in fact until its further rise was checked by diverting the water from the wheel. This action continued time after time until after further readings on the switchboard instruments were impossible and even until the very last movement of the inductor had ceased. In other words, the induction motor acted as a generator so long as there was the slightest movement to the inductor of the big generator.

As yet there is no well-defined consensus of opinion as to whether the induction motor is preferable to the synchronous motor for use in an exciter set such as that evolved in the Theberath combination. The induction motor has the very marked advantage of absolute simplicity, of extreme efficiency, of minimum attendance, and of incomparable compactness, but it is not capable of running in positive synchronism with the main generator. This will or will not be an advantage according to whether the speed of the main generator is uniform or not. It is more frequently than otherwise the case that the speed regulation of generators is not of the best, in which event the application of the Theberath idea with synchronous motors is distinctly analagous to running the exciter by belt-driving from the main generator shaft. It would appear, therefore, that in the majority of cases, the use of the induction motor will be found preferable to the use of the synchronous motor, while if the ultra refinement of exciter regulation is desired, the only remaining recourse will be to run a storage battery in parallel with the exciter. This is an expedient which, however, will probably be resorted to but seldom.

Gas

INDUSTRIAL GAS.—XIX.

BY FRANK H. BATES.

CALORIMETERS NOT REQUIRING AN OUTSIDE SOURCE OF OXYGEN.

LEWIS THOMPSON'S calorimeter. This is suitable to classes of work for which comparative results will suffice.

Description. This apparatus is composed of a glass jar, H, Figure 1, serving as a calorimeter bath and graduated to contain 1934 grams of water; of a cylindrical or bell shaped combustion chamber, D, with a cap or top into which is fastened

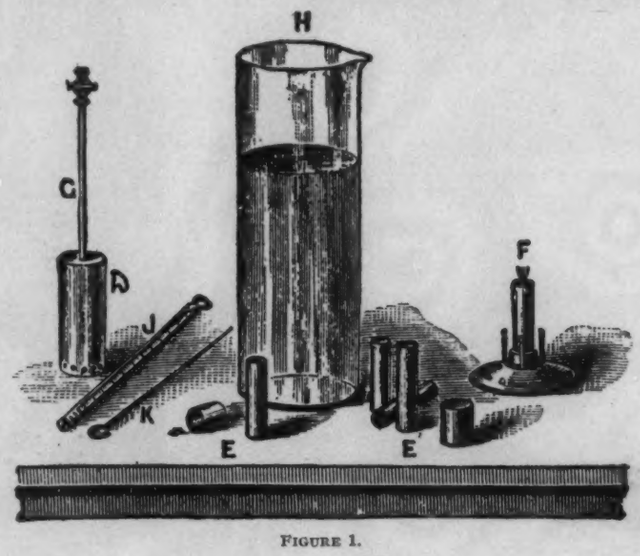

FIGURE 1.

a tube, C, provided with a stop-cock at its upper end, the capacity of the chamber being some 200 grams of water; of a copper cylinder, E, serving as a combustion and charging tube; of a stand, F; a thermometer, J, and cleaning wire, K, used for clearing the tube C.

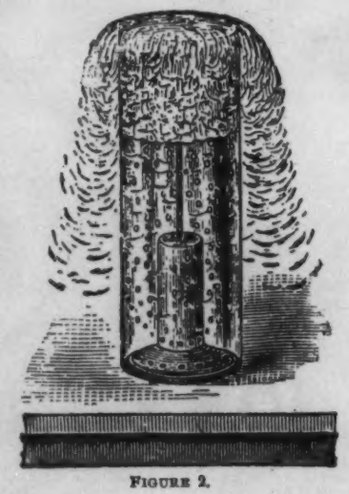

FIGURE 2.

Operation. The combustible is powdered and dried as per directions heretofore given. Two grams are carefully weighed out and intimately mixed with 22 grams of a very dry mixture of three parts by weight of potassic chlorate and one part of potassic nitrate; the whole is placed in the tube E and a fuse of nitrate of lead added. Lighting the fuse, introduce the tube E quickly into the combustion chamber D; attach or screw on the cap and place the whole in the water of the calorimeter. Combustion immediately takes place, the resulting gases rising to the surface. The weight of water used can be

proportioned to the weight of fuel as 966 to 1, so that each degree rise of temperature as noted on the thermometer J, placed within the calorimeter, will be equivalent to an evaporation of one gram of water per gram of combustible. As soon as the combustion ceases the rise in temperature is noted and to this is added a constant equal to the water equivalent of the calorimeter. This is readily determined by the use of a combustible of known calorific power in a preliminary test. The correction will generally be in the neighborhood of ten per cent.

The corrected reading gives the number of grams of water which a gram of combustible will evaporate, or when multiplied by 966 the number of British thermal units per pound of combustible.

The mixture of potassium chlorate and nitrate evolves oxygen gas and thus affords a supply which would otherwise have to be introduced.

The Parr Standard Calorimeter. An instrument based on the same general principles as the Thompson, but admitting of far greater refinement of operation has been lately brought out by the Standard Calorimeter Company, of Champaign, Ill., and is highly recommended as admitting of both rapid operation and accurate work. The instrument is suitable for both solid and liquid fuels.

The following calorific values obtained with this instrument are tabulated along with the results from a Mahler bomb calorimeter. There is given also the total percentages of combustible and also of inert matter, water and ash, in order to further show in a series of coals with small and large variations both the delicacy and accuracy with which results are indicated.

Sample..	Total inert matter.	Total combustibles.	B. T. U. by Parr St'nd'rd Calorimeter.	B. T. U. by Mahler bomb Calorimeter.
A.	4.38	95.60	14275	14270
B.....	9.87	90.13	12934	12914
C.....	11.45	88.55	12345	12355
D	11 80	88.20	12286	12289
E.....	13.72	86.28	12214	12205
F.....	21.28	78.72	11064	11025
G.....	27.47	72.53	10018	9986

The facility of operation may be shown by a brief description of the apparatus.

Figure 3 shows the cartridge in which is placed a weighed quantity of coal, previously ground to pass through a 100-mesh sieve and dried in the usual way at 105°—110° C. (220°—230° F.). There is also put into the cartridge a chemical compound which is thoroughly mixed with the coal by shaking. The cartridge is then placed in a measured quantity of water in the insulated calorimeter can A as shown in Figure 4. The stirrer is set in motion, operated by a cord about the pulley P. After a constant temperature has been attained, ignition is effected by means of a short piece of hot copper wire dropped through the stem of the cartridge.

Extraction of the heat is complete in from four to five minutes. The maximum reading is taken and the rise in temperature, multiplied by a simple factor, gives the heat in British thermal units per pound of coal.

Setting up of the instrument. The calorimeter should be placed on a good firm desk or table and accessible to motive power which may come from a small electric motor, electric fan, water motor or line shafting. The power needed is exceedingly slight, the smallest possible electric or water motor being ample. The speed when transmitted to the instrument should not be too high; 50 to 100 revolutions of the pulley attached to the calorimeter is sufficient.

The small rubber collar is to be slipped on the stem of the thermometer for supporting the same when passed through the lid of the calorimeter. It should be so placed as to bring the bulb of the thermometer about half way down from the top of the can. While other preparations are progressing, hang the thermometer near the calorimeter, in order to ascertain the temperature of the room.

Fill the two-litre flask to the mark with (preferably) distilled water that has been standing in the room and is approximately of the same temperature. This water may be used repeatedly. The calorimeter can should be removed from the instrument for filling. Inside of the can should be placed the deflecting collar and pivot. The cartridge for filling should be perfectly dry inside and out. If water has been admitted to the valve remove it from the stem by screwing off the knurled top and dry all parts thoroughly. To prepare the cartridge for filling, screw on the bottom firmly so as to avoid any possibility of admitting water to the interior, then place on a sheet of white paper.

The glass jar is for the chemical. Unscrew the top of one can only (4 oz.) of chemical and empty completely into the glass jar. Put the measuring cup and handle entire inside, place on and clamp down the glass cover. Wash out and throw the empty can away. When the chemical thus transferred to the jar is about exhausted by use, the contents of the second can may be similarly transferred. One can at a time only is to be put into the jar. There will thus be left room for the measuring device and space for handling the same. Do not leave the measure out in the air but replace and clamp the glass jar cover as quickly as possible. If it should become necessary to clean the measure do so with water and dry thoroughly before placing in the jar.

The directions for manipulation follow. After the final reading in a test has been taken, dismantle by first carefully removing and hanging up the thermometer. After removing the pulley and cover, take out the can entire, then remove the cartridge from the water, remove the spring clips with vanes, unscrew the ends, clean them at once with a dry towel and place the cartridge under the tap or in a basin of water. The chemical should dissolve out rapidly and in a few minutes the cartridge will be ready for rinsing and drying. Dissolving the contents of the cartridge in a basin has the advantage of indicating whether the combustion is perfect or not. Of course,

precipitated iron and ash will always be in evidence. The result is still better shown by acidifying with commercial hydrochloric acid, when practically a clear solution should result.

Manipulation. The coal, properly sampled and air dry, should be ground in a mortar and passed through a 100-mesh sieve. The amount so treated need not be large, an ounce or less being sufficient. Upon a carefully counterpoised watch glass weigh exactly one-half gram and place in the oven to dry. The oven should be maintained at 105° to 110° C. The coal will be sufficiently dry in 45 minutes. If, however, an accurate determination of the water is desired, it should remain in the oven at the avove temperature for one hour, and cooled in a

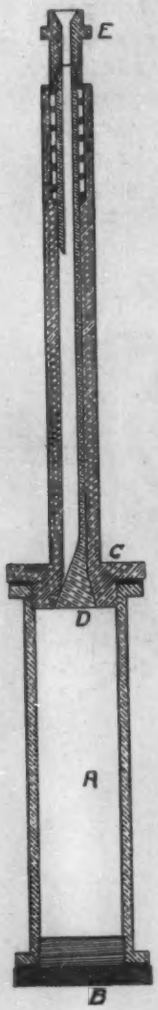

FIGURE 3.

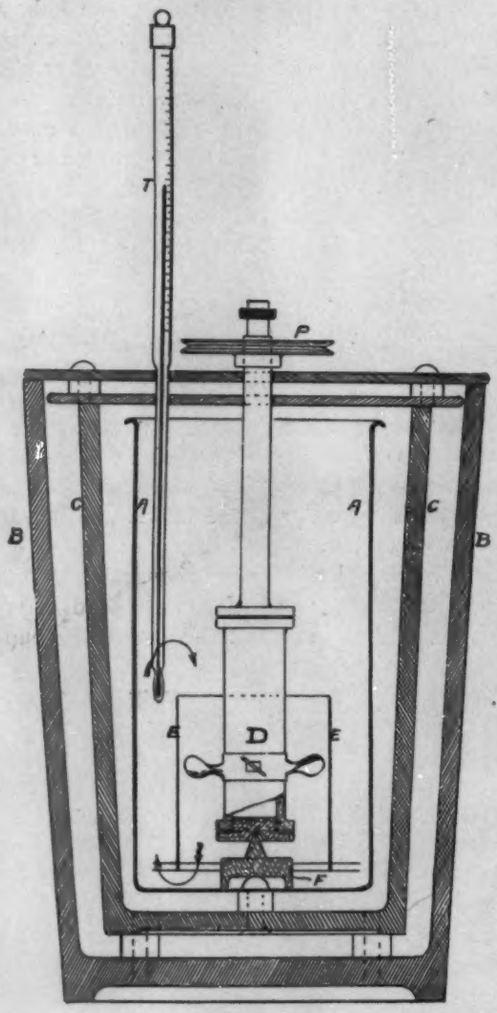

FIGURE 4.

desiccator or in ground clamped watch glasses before weighing the second time. For the calorific test the determination of the water is not necessary, hence after 45 minutes in the oven at the proper temperature the sample is swept directly into the cartridge which has been made ready by screwing the bottom B (Figure 3) firmly in place and removing the top C (Figure 3) with stem and valve. The cartridge should stand on a sheet of white paper in order that any particles of coal lost in transferring from the watch glass may be caught and returned to the cartridge. One measure of the chemical is now added and the top (C) of the cartridge at once screwed on firmly and the whole well shaken to thoroughly mix the contents.

The chemical measure is adjusted to hold very nearly 8½ or 9 grams of material when tapped to settle the contents and at the same time shake off the excess at the top so that it will conform somewhat to a "struck" measure. Extreme accuracy in this regard is not essential. Be sure, however, that the measure has been filled with chemical to the exclusion of large cavities that may tend to form. Return the measure to the chemical receptacle at once and keep the whole covered and clamped to exclude moisture.

In shaking the cartridge hold the thumb against the valve stem (E) to prevent its opening during the shaking thus admitting the material past the valve (D) into the stem. When the mixing is complete tap the cartridge lightly on the bottom to settle the contents and to shake all the material from the upper part of the cylinder. Tap the valve also to see that it works freely. Put on the spring clips with vanes. The cartridge is now ready for inserting in the can. The can is made ready by standing it outside the apparatus and adding thereto 2000 cubic centimeters of distilled water which has been previously brought to a temperature a little below that of the room; say about 2° F. This adjustment of the temperature of the water should be made while it is yet in the two-litre flask. If too warm allow the tap water to flow over the flask. If too cold pour a little into a beaker and heat over a Bunsen burner; or better still, if available, hold the flask under the hot water faucet. Mix the water in the flask before thus roughly taking the temperature. The temperature of the room should be about midway between the initial and final temperature of the water, and since the average coal gives a total rise of about 4° F. for one half gram, it is a simple matter to know approximately what the initial temperature of the water should be. It is well to make a note in the data of the experiment what the temperature of the room is.

Pour the water into the can and lift the same into the apparatus. The pouring in of the water should be made with the can removed to avoid getting any moisture on the outside of the can or in the air spaces. Now insert the cartridge, adjust the cover, place the thermometer so the bulb will extend about half way to the bottom of the can, place the pulley on the stem and connect with the motor. The general arrangement of parts is shown in Figure 5. Too rapid revolving of the cartridge should be avoided, 50 to 100 revolutions per minute being sufficient. The cartridge should turn to the right, or as the hands of a watch, thus deflecting the water currents downward. Read the thermometer carefully with the glass. After a few minutes constant temperature should be reached. The instrument should have been in the room for an hour before a test. Bringing the instrument from a cold room to work at once in a warm one, or *vice versa*, should be avoided. Note the reading and ignite the charge. The copper wire for this purpose is of No. 12

gage and three-eighths of an inch long. It should be held by one end in the tip of the flame until red hot; drop quickly into the opening at the upper end of the valve and press the valve with the pincers immediately after letting go of the wire. The valve should not be held down, but released and allowed to spring back as

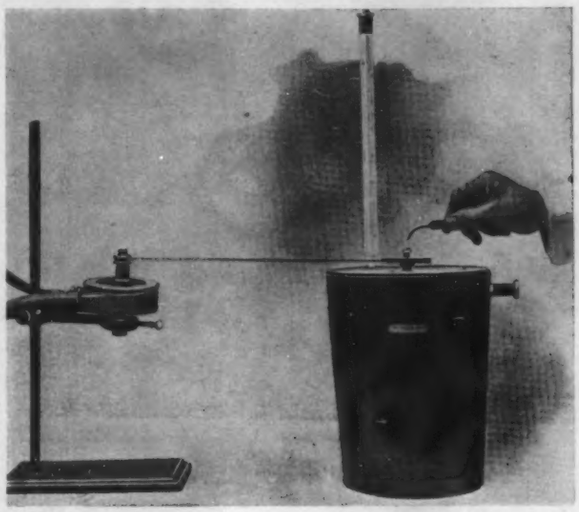

FIGURE 5.

quickly as possible. All the time, of course, the revolving of the cartridge continues. The combustion should be indicated by a rapid rise of the mercury which reaches its maximum height after about five minutes. Make note of the final temperature and compute as follows:

Derivation of results—

The rise in temperature is corrected for the heat of the wire by subtracting .015°. The difference is the actual rise r due to the total reaction inside of the cartridge. Multiply r by the factor 3100. and the product equals the British thermal units per pound of coal. In case a centigrade thermometer is used the correction factor to be subtracted is .009° and the final result is in kilocalories which may be changed to British thermal units by multiplying by 1.8

The factor 3100. is deduced as follows: The water used plus the water equivalent of the metal in the instrument amounts to 2123.5 grams. In the reaction 73 per cent. of the heat is due to combustion of the coal and 27 per cent. is due to the heat of combination of CO_2 and H_2O with the chemical.

If now one-half gram of coal causes 2123.5 grams of water to rise r degrees, and if only 73 per cent. of this is due to combustion, then—

$.73 \times 2123.5 \times 2 \times r =$ rise in temperature that would result from combustion of an equal weight (2123 grams) of coal. $.73 \times 2123.5 \times 2 = 3100.00$.

The rise in temperature would of course be the same for any other quantities of coal and water that were equal in amount—as one pound of coal and a pound of water—hence the "British thermal units per pound of coal."

Special hints—

(*a*) The moisture in "air dry" coal may vary from 1 to 15 or more per cent. When this quantity does not exceed 2 or 3 per cent., the error introduced in the reaction by not removing it would be too small to be of technical consequence. It is better, however, in all cases, to dry the coal as directed.

(*b*) In the case of coke, drying is usually unnecessary. Ashes, if they have been sprinkled, should of course be dried. Ashes, and sometimes coke, ignite with difficulty. In such cases add a second charge of chemical and one-half gram of some good coal, the factor of which has been determined, mix the two charges thoroughly by shaking and ignite. The coal will carry along the combustion of the entire mass. Calculate the British thermal units as usual and subtract the British thermal units due to the coal.

(*c*) The receptacle for the chemical is so arranged that with the contents of one can of chemical in the bottom there is still room in the jar for the measure and handle complete. The measure should always be replaced in the jar and the cover clamped on.

(*d*) Do not spill the chemical. Do not pour a mixture of the chemical and coal into water; it may ignite violently. The chemical thrown into wet excelsior or damp organic matter may cause ignition. If much is spilled on the hands wash thoroughly at once. The fine dust

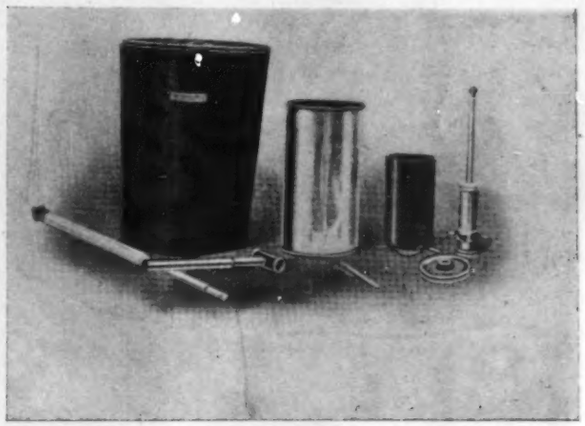

FIGURE 6.

that may be breathed into the nostrils is harmless; use care and common sense. There should be no more liability to accident than in the use of any other caustic.

(*e*) Ignite quickly after reading the thermometer. A good flame should heat the wire to a bright red in ten seconds.

(*f*) Thermometers are Fahrenheit and graduated to $\frac{1}{20}$ of a degree. Each division is .05°, two divisions are 10°. The next larger divisions are .25°.

(*g*) A sample of coal ground so finely, even if carefully kept in a corked bottle, slowly deteriorates. An appreciable loss may be noticed after a week, and as much as two per cent. deterioration has been noted

after a lapse of six or eight weeks. The lump or pea samples are not thus affected.

(*h*) In reading the thermometer always adjust the glass so as to bring the top of the mercury at the center of the lens.

The description and directions for operation of this instrument were kindly furnished the writer by the Standard Calorimeter Company.

(To be continued.)

Personal

L. B. PEMBERTON, so long identified with the electric railway interests in Los Angeles, has accepted the superintendency of the Santa Barbara (Cal.) Consolidated Electric Company.

JAMES H. BARBOUR, of Los Angeles, has been elected president of the Riverside Power Company, which proposes to erect a transmission plant on the Santa Ana River nine miles below Riverside.

G. J. G. BRANDT, who was engaged in electric power transmission work in the interior of the state some two years or more ago, has been appointed electrical engineer to the city of Amsterdam, Holland.

E. W. GOLDSCHMIDT, who is remembered so kindly by San Franciscans as the representative of the Western Electric Company, Chicago, at the Midwinter Fair, has retired from the services of the company named in order to accept the position of assistant to H. B. Foster, manager of the Chicago district office of the Bullock-Wagner sales organization.

CARL H. HOLLEY, superintendent of the Mount Whitney Power Company, Visalia, Cal., and Miss Grace Woodward, the accomplished daughter of Mr. and Mrs. A. G. Woodward, were married at the residence of the bride's parents in Tulare on May Day. The bride is a musician of great ability and is one of the most charming of Tulare's daughters. She was a general favorite in social circles in her home city and will be a decided acquisition to the society of Visalia. Mr. Holley is a graduate of Stanford University and for the past two years has been superintendent of the Mount Whitney Power Company, a position he has filled with marked success.

TRADE LITERATURE.*

Westinghouse Bulletins, No. 1037, "Engine-Type Alternators," specially interesting as descriptive of large units, such as are used by the Independent Electric Light and Power Company, San Francisco.

General Electric Bulletins, No. 4238, "Railway Motor Controllers" of the G. E. types, are illustrated, their functions and objects of each such type are given, as well as diagrams showing motor combinations. This i an indispensible bulletin to all railway men.—General Elect ic Co.

"The Leeds Portable Testing Sets," is a 32-page catatogue (No. 340) for 1901, which, though it is obviously an advertising pamphlet,is in reality a truly valuable discussion of the principles of construction and the methods of handling modern high grade electrical testing instruments. Such a catalogue as this is a publication of greatest merit. James G. Biddle, 1024-5 Stephen Girard Bldg., Philadelphia.

"Aging of Transformer Iron." a 92-page pamphlet on this subject, which contains five important articles that have been issued regarding this subject, as follows: "The Aging of Transformer Iron," by Prof. W. Elwell Goldsborough; "On Slow Changes in the Magnetic Permeability of Iron," by W. Mordey; "Effects of Prolonged Heating on the Magnetic Properties of Iron," by S. R. Roget, B. A.; "Hysteresis in Sheet Iron and Steel," by Arthur Hillyer Ford; and "The Aging of Transformer and Steel," by J. A. Capp. This pamphlet is one that should be in the hands of every central station manager, and will be furnished free of charge upon application to the General Electric Company.

Stanley Bulletin No 114, illustrates and describes the S. K. C. Frequency Changer, a single machine accomplishing exactly what its name implies. In addition to altering the periodicity, it can be arranged to deliver current of a different phase relation and voltage from that which is supplied. Bulletin No. 115 contains diagrams and a description of High Voltage Testing Sets, arranged for pressures up to 120,000 volts. Stanley Electric Mfg. Co., Jno. Martin & Co., Pacific Coast Agents, San Francisco.

*Catalogues mentioned in this department will be mailed gratuitously on application to the concerns publishing them. When writing, mention THE JOURNAL OF ELECTRICITY, POWER AND GAS. Where addresses are not given, they may be found through reference to the Advertisers' Index on page v.

Industrial

In responding to advertisements in this publication kindly mention "The Journal of Electricity, Power and Gas."

A BULLOCK AND WAGNER SALES COMBINATION.

The Bullock Electric Manufacturing Company, of Cincinnati, and the Wagner Electric Manufacturing Company, of St. Louis, have effected a combination of their selling organizations. This combination is possible inasmuch as the products of the two companies are totally different, and where the product of one is used, the other is likely to be necessary.

The product of the Bullock company consists of a complete line of direct and alternating current machines, from a one-half horsepower motor to a 10,000-kilowatt generator; controllers of various types and rotary transformers. The Bullock "Teaser" power system for driving large daily newspaper presses has become world-famous, and is today installed in the pressrooms of the leading dailies in Europe and America. The product of the Wagner Electric Manufacturing Company covers a full line of static transformers of all types and of the largest sizes; ammeters, voltmeters, indicating wattmeters, switches, switchboards for all purposes, and single-phase, self-starting, alternating-current motors. Thus it will be seen that the two lines are admirably adapted to be sold by one organization, which will be under the management of E. H. Abadie, formerly sales manager of the Wagner company.

STANLEY SALES OFFICES.

The Stanley-Electric Manufacturing Company, of Pittsfield, Mass., has found it expedient, in order to take better care of their large southern trade, to establish another sales office in the South, this one at Winston-Salem, N. C., with F. A. Barr as district manager. The Stanley company's other southern office is at Rock Hill, S. C., and is in charge of F. C. Whitner.

In addition to the above mentioned offices, the Stanley company now has branch sales offices located as follows: 71 Broadway, New York City; Equitable Building, Boston, Mass.; 26 South Fifteenth street, Philadelphia; 31-33 New Montgomery street, San Francisco, Cal.; Pioneer Building, Seattle, Washington, and Madison, Wis.

Good incandescent electric lamps are appreciated everywhere, and that the Colorado Lamp is a good lamp is found in the fact that they were selected in preference to all others by the New Zealand Government for the grand illuminations which were held there recently in honor of visiting royalty. See advertisement for sales agencies.

The editor of the *Sibley Journal of Mechanical Engineering*, published by the students of Sibley College, Cornell University, writes that he considers THE JOURNAL to be "one of our most interesting exchanges."